



Designation: A886/A886M – 16

# Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete<sup>1</sup>

This standard is issued under the fixed designation A886/A886M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers two types and two grades of indented seven-wire uncoated, steel strand for use in prestressed concrete construction. The two types of strand are low-relaxation and stress-relieved (normal-relaxation). Grade 250I [1725I] and Grade 270I [1860I] have minimum tensile strengths of 250 ksi [1725 MPa] and 270 ksi [1860 MPa], respectively, based on the nominal area of the strand.

1.2 This specification is applicable for orders in either inch-pound units (as Specification A886) or in SI units (as Specification A886M).

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the specification.

## 2. Referenced Documents

2.1 *ASTM Standard*:<sup>2</sup>

A1061/A1061M Test Methods for Testing Multi-Wire Steel Prestressing Strand

2.2 *U.S. Military Standard*:

MIL-STD-129 Marking for Shipment and Storage<sup>3</sup>

2.3 *U.S. Federal Standard*:

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)<sup>3</sup>

## 3. Terminology

3.1 *Definition of Term Specific to this Specification*:

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

Current edition approved Dec. 1, 2016. Published January 2017. Originally approved in 1988. Last previous edition approved in 2012 as A886/A886M – 12. DOI: 10.1520/A0886\_A0886M-16.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

3.1.1 *strand, n*—a group of wires having a center wire enclosed tightly by six helically placed outer wires with uniform pitch of not less than 12 and not more than 16 times the nominal diameter of the strand.

3.1.1.1 *Discussion*—The direction of lay is either right-handed or left-handed.

## 4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements to be considered include, but are not limited to, the following:

4.1.1 Quantity (feet [metres]),

4.1.2 Nominal diameter of strand (inches [millimetres]),

4.1.3 Grade of strand,

4.1.4 Type of strand (low-relaxation or stress-relieved (normal-relaxation)),

4.1.5 Other types of indented wire (7.4.2),

4.1.6 If joints or splices are permitted (8.1.1),

4.1.7 Weldless, if desired (8.1.4),

4.1.8 Inspection (11.1),

4.1.9 Load-elongation curve, if desired (13.2),

4.1.10 Packaging (4.1), and

4.1.11 ASTM designation and year of issue.

## 5. Materials and Manufacture

5.1 *Base Metal*—The base metal shall be carbon steel of such quality that when it is drawn to wire, subjected to the indentation process, fabricated into strand, and then thermally treated, it shall have the properties and characteristics prescribed in this specification.

5.2 *Wire*—The wire from which the strand is to be fabricated shall have a common dry-drawn finish.

NOTE 1—This product is a composite of seven wires and is produced to only the prescribed mechanical properties. The chemical composition of all wires or any individual wire is not pertinent to this application, and heat identity is not necessarily maintained. It is possible that wire from more than one heat may be used in the manufacture of a reel or reelless pack. Traceability is based on the identity of reels or reelless packs as maintained and reported by the manufacturer.

5.3 *Indentations*—The outer wires shall have indentations that inhibit longitudinal movement of the strand relative to the

\*A Summary of Changes section appears at the end of this standard

**TABLE 1 Nominal Dimensions of Indentations**

Fig.	Wire Diameter, <i>d</i>		Nominal Diameter of Strand		Depth, <i>a</i>		Length, <i>L</i>		Pitch, <i>P</i>	
	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]
1 (a)	≤ 0.104	[≤ 2.6]	0.312	[7.9]	0.002 to 0.004	[0.05 to 0.10]	0.079	[2.0]	0.220	[5.6]
1 (a)	> 0.125	[> 3.2]	0.375	[9.5]	0.002 to 0.005	[0.05 to 0.13]	0.108	[2.7]	0.220	[5.6]
			0.438	[11.1]						
			0.500	[12.7]						
1 (b)	≤ 0.125	[≤ 3.2]	0.375	[9.5]	0.002 to 0.006	[0.05 to 0.15]	0.115	[2.9]	0.220	[5.6]

concrete surrounding the strand in prestressed concrete construction. Indentations shall conform to the provisions in Section 7.4. The surface of the outer wires shall be suitably deformed mechanically by rolling to produce a series of indentations. Indentations shall be in two or more lines spaced uniformly around the wire. Indentations in adjacent lines shall be staggered throughout the length of the wire. At least 90 % of the indentations in any 2 ft [0.6 m] length of strand shall meet the pitch and shape requirements of Table 1. The center wire need not be indented.

5.4 *Treatment*—After stranding, low-relaxation strand shall be subjected to a continuous thermal-mechanical treatment to produce the prescribed mechanical properties. For stress-relieved (normal-relaxation) strand, only thermal treatment is necessary. Temper colors which result from the stress-relieving operation are considered normal for the finished appearance of this strand.

## 6. Mechanical Property Requirements

6.1 Tests for mechanical properties shall be conducted in accordance with Test Methods A1061/A1061M.

6.2 *Breaking Strength*—The breaking strength of the finished strand shall conform to the requirements prescribed in Table 2.

6.3 *Yield Strength*—Yield strength in lbs [kN] shall be measured at 1 % extension under load. The minimum yield strength shall be 90 % for low-relaxation strand and 85 % for stress-relieved (normal-relaxation) strand of the breaking strength listed in Table 2. Initial loads for the test and minimum yield strengths are listed in Table 3.

6.3.1 The extension under load shall be measured by an extensometer calibrated with the smallest division not larger than 0.0001 in./in. [0.0001 mm/mm] of gage length.

6.4 *Elongation*—The total elongation under load shall not be less than 3.5 % using a gage length of not less than 24 in. [600 mm]. It shall be permissible to determine the total elongation value by adding to the 1 % yield extension the percent extension or movement between the jaws gripping the strand after yield determination. The percent is calculated on the new base length of jaw-to-jaw distance.

6.5 *Relaxation Properties*—Low-relaxation strand shall have relaxation losses of not more than 2.5 % when initially loaded to 70 % of specified minimum breaking strength or not more than 3.5 % when loaded to 80 % of specified minimum breaking strength of the strand after 1000 hours of testing.

**TABLE 2 Breaking Strength Requirements**

Nominal Diameter of Strand		Breaking Strength of Strand, lbf [kN]	Steel Area of Strand, in. <sup>2</sup> [mm <sup>2</sup> ]	Mass [Weight] of Strand, lb/1000 ft [kg/1000 m]
in.	[mm]			
Grade 250I [1725I]				
0.250	[6.4]	9 000 [40.0]	0.036 [23.2]	122 [182]
0.313	[7.9]	14 500 [64.5]	0.058 [37.4]	197 [294]
0.375	[9.5]	20 000 [89.0]	0.080 [51.6]	272 [405]
0.438	[11.1]	27 000 [120.1]	0.108 [69.7]	367 [548]
0.500	[12.7]	36 000 [160.3]	0.144 [92.9]	490 [730]
0.600	[15.2]	54 000 [240.5]	0.216 [139.4]	737 [1094]
Grade 270I [1860I]				
0.313	[7.9]	16 500 [74.3]	0.061 [39.4]	210 [313]
0.375	[9.5]	23 000 [101.9]	0.085 [54.8]	290 [432]
0.438	[11.1]	31 000 [138.0]	0.115 [74.2]	390 [582]
0.500	[12.7]	41 300 [183.6]	0.153 [98.7]	520 [775]
0.600	[15.2]	58 600 [260.4]	0.217 [140.0]	740 [1102]

**TABLE 3 Yield Strength Requirements<sup>A</sup>**

Nominal Diameter of Strand		Initial Load, lbf [kN]	Minimum Load at 1 % Extension, kN [lbf]	
in.	[mm]		Stress-Relieved (Normal Relaxation) <sup>A</sup>	Low Relaxation <sup>B</sup>
Grade 1725I [250I]				
0.250	[6.4]	900 [4.0]	7 650 [34.0]	8 100 [36.0]
0.313	[7.9]	1 450 [6.5]	12 300 [54.8]	13 050 [58.1]
0.375	[9.5]	2 000 [8.9]	17 000 [75.6]	18 000 [80.1]
0.438	[11.1]	2 700 [12.0]	23 000 [102.3]	24 300 [108.2]
0.500	[12.7]	3 600 [16.0]	30 600 [136.2]	32 400 [144.3]
0.600	[15.2]	5 400 [24.0]	45 900 [204.4]	48 600 [216.5]
Grade 1860I [270I]				
0.313	[7.9]	1 650 [7.3]	14 030 [63.2]	14 850 [66.9]
0.375	[9.5]	2 300 [10.2]	19 550 [86.6]	20 700 [91.7]
0.438	[11.1]	3 100 [13.8]	26 350 [117.3]	27 900 [124.2]
0.500	[12.7]	4 130 [18.4]	35 000 [156.1]	37 170 [165.2]
0.600	[15.2]	5 860 [26.1]	49 800 [221.3]	52 740 [234.4]

<sup>A</sup> Minimum yield strength is 85 % of specified minimum breaking strength.

<sup>B</sup> Minimum yield strength is 90 % of specified minimum breaking strength.

6.5.1 If required, relaxation evidence shall be provided from the manufacturer's records of tests on similarly dimensioned strand of the same grade.

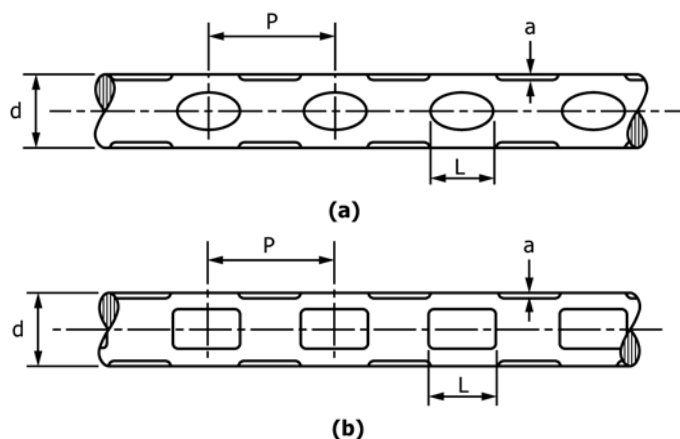
## 7. Dimensions and Permissible Variations

7.1 The size of the finished strand shall be expressed as the nominal diameter of the strand in inches [mm]. All nominal dimensional requirements for wires and strands shall refer to the wire and strand before indenting.

7.2 The diameter of the center wire of any strand shall be larger than the diameter of any outer wire in accordance with Table 4.

**TABLE 4 Diameter Relation Between Center and Outer Wires**

Nominal Diameter of Strand		Minimum Difference Between Center Wire Diameter and Diameter of Any Outer Wire	
in.	[mm]	in.	[mm]
Grade 1250I [1725I]			
0.250	[6.4]	0.001	[0.025]
0.313	[7.9]	0.0015	[0.038]
0.375	[9.5]	0.002	[0.051]
0.438	[11.1]	0.0025	[0.064]
0.500	[12.7]	0.003	[0.076]
0.600	[15.2]	0.004	[0.102]
Grade 270I [1860I]			
0.313	[7.9]	0.0015	[0.0381]
0.375	[9.5]	0.002	[0.0508]
0.438	[11.1]	0.0025	[0.0635]
0.500	[12.7]	0.003	[0.0762]
0.600	[15.2]	0.004	[0.1016]



**FIG. 1 Acceptable Types of Indented Wire**

### 7.3 Permissible Variations in Diameter:

7.3.1 All Grade 250I [1725I] strand shall conform to a size tolerance of  $\pm 0.016$  in. [ $\pm 0.40$  mm] from the nominal diameter measured across the crowns of the wire.

7.3.2 All Grade 270I [1860I] strand shall conform to a size tolerance of  $+0.026$  in.,  $-0.006$  in. [ $+0.65$  mm,  $-0.15$  mm] from the nominal diameter measured across the crowns of the wire.

7.3.3 Variation in cross-sectional area and in stress resulting therefrom shall not be cause for rejection provided the diameter differences of the individual wires and the diameters of the strand are within the tolerances specified.

### 7.4 Indentations:

7.4.1 Two acceptable types of indented wire are shown in Fig. 1 (a) and (b) with dimensions given in Table 1.

7.4.2 Other types of indented wire are permitted, by agreement between the purchaser and manufacturer.

## 8. Workmanship, Finish, and Appearance

### 8.1 Joints:

8.1.1 There shall be no strand joints or strand splices in any length of the completed strand unless specifically permitted by the purchaser.

8.1.2 During the process of manufacture of the individual wires for stranding, welding is permitted only prior to or at the size of the last thermal treatment, for example, patenting or control cooling. There shall be no welds in the wire after it has been drawn through the first die in the wire drawing except as provided in 8.1.3.

8.1.3 During fabrication of the strand, butt-welded joints are permitted in the individual wires, provided there is not more than one such joint in any 150-ft [45-m] section of the finished strand.

8.1.4 When specifically ordered as “Weldless,” a product free of welds shall be furnished. When “Weldless” is specified, the strand is produced as one continuous length with no welds as allowed in 8.1.3.

8.2 The finished strand shall be uniform in diameter and shall be free of imperfections.

8.3 When strand is cut without seizing, if no wire flies out of position, or if any wire that flies out of position can be repositioned by hand, the strand shall be considered satisfactory.

8.4 The strand shall not be oiled or greased. Slight rusting, provided it is not sufficient to cause pits visible to a person with normal or corrected vision, shall not be cause for rejection.

## 9. Sampling

9.1 Test specimens cut from either end of the reels or reelless packs are permitted. Any specimen found to contain a wire joint shall be discarded and a new specimen obtained.

## 10. Number of Tests

10.1 One test specimen shall be taken from each 30-ton [27-tonne] production lot of finished strand and tested for breaking strength, yield strength, and elongation.

## 11. Inspection

11.1 If outside inspection is required, the manufacturer shall afford the inspector representing the purchaser reasonable access to the facilities, which concern the manufacture of the material ordered, to satisfy the inspector that the material is being furnished in accordance with this specification. All tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise agreed upon at the time of purchase, and shall be so conducted as not to interfere unnecessarily with the manufacturer’s operations.

## 12. Rejection

12.1 Failure of any test specimen to comply with the requirements of this specification shall constitute grounds for rejection of the lot represented by the specimen.

12.2 The lot may be resubmitted for inspection by testing a specimen from each reel or reelless pack and sorting out non-conforming material.

12.3 If there is a reasonable doubt in the initial testing as to the ability of the strand to meet any requirement of this specification, two additional tests shall be made on specimens



from the same reel or reelless pack, and if failure occurs in either of these tests, the represented reel or reelless pack shall be rejected.

### **13. Certification**

13.1 If outside inspection is not required, a manufacturer's certification that the material has been tested in accordance with and meets the requirements of this specification shall be the basis of acceptance of the material. The certification shall include Specification A886/A886M, year-date of issue, and revision letter, if any.

13.2 When requested in the purchase order or contract, the manufacturer shall furnish a representative load-elongation curve for each size and grade of strand shipped.

13.3 When the modulus of elasticity of a seven-wire strand is provided, the cross-sectional area used to compute that modulus shall also be provided. The area provided in the certification shall be the area used to calculate the modulus of elasticity.

13.4 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document shall meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the manufacturer. Notwithstanding the

absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 2—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

### **14. Packaging and Package Marking**

14.1 The strand shall be furnished on reels or reelless packs having a minimum core diameter of 24 in. [600 mm], unless otherwise specified by the purchaser. Lengths on reels or in reelless packs shall be as agreed upon at the time of purchase. The strand shall be well protected against mechanical injury in shipping as agreed upon at the time of purchase. Each reel or reelless pack shall have two durable tags securely fastened to it showing the length, size, grade, Specification A886/A886M, and the name or mark of the manufacturer. One tag shall be positioned where it will not be inadvertently lost during transit, such as inside the core of a reelless pack. The other tag shall be placed on the outside for easy identification.

14.2 When specified in the purchase order or contract, and for direct procurement by or direct shipment to the U.S. government, marking for shipment, addition to requirements specified in the purchase order or contract, shall be in accordance with Fed. Std. No. 123 for use by civil agencies and MIL-STD-129 for use by military agencies.

### **15. Keywords**

15.1 indentations; prestressed concrete; seven-wire strand (tendon); steel wire

## **SUMMARY OF CHANGES**

Committee A01 has identified the location of selected changes to this standard since the last issue (A886/A886M – 12) that may impact the use of this standard. (Approved Dec. 1, 2016.)

(1) Revised 3.1.1.1 and 10.1.

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